

CHAPTER 15

RIPRAP

Introduction

Riprap is used to protect a slope against erosion or scour. It is placed where vegetation or other methods would be ineffective or impracticable.

At the present time a number of different types of riprap are being employed. They are:

- Dumped Riprap
- Revetment Riprap
- Class 1 or 2 Riprap
- Grouted Riprap
- Precast Cement Concrete Riprap
- Uniform Riprap

No matter what type is used it is necessary to place the riprap on good grade. The foundation grade should be stable and true. Without these, the riprap may be ineffective.

Dumped Riprap

Dumped riprap can consist of several different types of material. It is often waste material that may be on the project. Dumped riprap can consist of any of the following:

- Broken concrete, masonry, or stone removed from an old structure.
- Broken pieces removed from concrete pavement, base, or monolithic brick pavement.
- Broken rock from Class X or Class Y, unclassified excavation.
- Broken rock from solid rock excavation.
- Material produced from sources outside the right-of-way shall be coarse aggregate, class F or higher.
- Steel slag

**Continuation of
Dumped Riprap**

Dumped riprap is to be placed at locations shown on the plans or as directed by the Project Engineer. Its placement shall conform to the following characteristics:

- A finished surface of approximate regularity.
- A finish surface varying no more than 9" from a true plane.
- A thickness of no more than 2 feet nor less than 1 foot. The thickness being measured perpendicular to its surface.

**Revetment,
Class 1 and
Class 2 Riprap**

Revetment riprap is probably the most commonly used riprap. Revetment riprap and class 1 and class 2 riprap shall consist of aggregate, Class F or higher. It shall be in accordance with 904.04 for gradation and such that the maximum dimension of an individual piece shall not be greater than three times the minimum dimension.

Stone containing shale, unsound sandstone, or any other material which will disintegrate readily should not be used.

The above listed materials for Revetment Riprap should have a gradation such that:

- 100% of the materials passes a 18" sieve
- 90 to 100% of the material passes a 12" sieve.
- 20 to 40% of the material passes a 6" sieve.
- Not more than 10% of the material passes a 3" sieve.

Continuation of

Revetment,
Class 1 and
Class 2 Riprap

Revetment riprap, Class 1 and Class 2 riprap may be placed by dumping. Revetment riprap is usually placed with a thickness of 18 inches. The finished surface shall vary no more than 9 inches from true plane, and be free from small clusters of small or large stones. It is placed at locations as shown on the plans or as directed by the Project Engineer.

Grouted Riprap

Grouted riprap is to have the same:

- Aggregate
- Preparation of slope
- Method of placement

As that for revetment, Class 1 and Class 2 riprap

After the aggregate has been placed and accepted all interspaces are to be filled with a cement grout. Interspaces are the small spaces between the spalls and the larger aggregate. The grout should be composed of 1 part Portland cement to 4 parts of No. 23 fine aggregate. Water should be added during mixing until the grout attains a consistency which will allow it to flow into the interspaces.

The finished surface of grouted riprap should be:

- Smooth
- Solid
- True to line
- True to grade
- True to section

Pre-cast
Cement
Concrete &
Riprap

Precast concrete riprap consists of unreinforced concrete units. The nominal thickness will be detailed on the plans or proposal. These units are to meet concrete compressive strength qualities and therefore require that samples be taken. The number of samples to be obtained is outlined in the Frequency Manual.

The slope on which in riprap is to be placed should be the cross section as shown on the plans. The laying procedure will follow the following format:

- Laying should begin in a trench below the toe of the slope and progress upward.
- Each piece should be laid by hand perpendicular to the slope.
- Each piece should be firmly embedded against the slope in such manner that the vertical joint space between individual units does not exceed 3/8 of an inch.
- Half blocks, odd shaped blocks, or class A concrete should be used to fill the voids at the ends of sections to be placed or on curved shape sections.
- The top course should conform with the prescribed berm or shoulder elevation. Any adjustment necessary to achieve this should be obtained by constructing a wedge course near the tip of the slope. This wedge course should be of class A concrete or one to two mortar. The toe wall, when required, shall consist of class A concrete.

Uniform
Riprap

Uniform riprap shall be placed to produce a surface of approximate regularity with edges having projections no more than 3 in. above the required cross section. The material shall be hand laid or placed by other approved means. Graduation will be according to 904.04 (e).

Measurement

Not all riprap types are measured and paid for the same. Below is a table summarizing the different types and the measuring and payment application of each.

Type and Conditions	Measuring & Pay
Revetment and Dumped from Within R/W if shown on the plans	No Payment
Revetment and Dumped from within R/W if placement not shown on the plans.	Square Yards
Revetment, Class 1, Class 2, Outside of R/W	Tons
Uniform Riprap	Tons
Precast concrete Riprap	Square Yards
Dumped using blast furnace slag as material	Order planned tonnage x 2.3 / 2.6 Pay tonnage received X 2.6 / 2.3

Acceptance

Riprap that is taken from the R/W can be accepted visually by the Project Engineer. Riprap received from off the project must be visually accepted by the Testing Department. A CAPP "D" number is required for the basis for approval. These numbers are needed for project materials records. Therefore the Certified Technician should be sure that the riprap has been tested. Precast concrete riprap requires actual sampling. The number of samples needed is dependent upon the number of units required. The frequency manual outlines the number of samples required per units used.